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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/810,415	03/25/2004	Miika Leinikka	ASMMC.057AUS	8921

20995 7590 09/06/2007
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EXAMINER

CHAMBLISS, ALONZO

ART UNIT	PAPER NUMBER
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2814

NOTIFICATION DATE	DELIVERY MODE
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09/06/2007

ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

jcartee@kmob.com
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Office Action Summary	Application No. 10/810,415	Applicant(s) LEINIKKA ET AL.	
	Examiner Alonzo Chambliss	Art Unit 2814	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 29 June 2007.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-28, 33-47, 51, 52 and 63-66 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 1-28 is/are allowed.
- 6) ☒ Claim(s) 33-47, 51, 52 and 63-66 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 5/2/06 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Response to Arguments

1. Applicant's arguments, see remarks, filed 6/29/07, with respect to the rejection(s) of claim(s) 1-28, 33-47, 51, 52, and 62-66 under 102 and 103 rejections have been fully considered and are persuasive. Therefore, the rejection has been withdrawn.

However, upon further consideration, a new ground(s) of rejection is made in view of Soininen et al. (US 6,482,740) and Wu et al. (US2005/0110147).

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to

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consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

3. Claims 33-37, 44, 45, 52, and 63-66 are rejected under 35 U.S.C. 103(a) as being unpatentable over Soininen et al. (US 6,482,740) in view of Wu et al. (US 2005/0110147).

With respect to Claims 33 and 63-66, Soininen teaches depositing a diffusion barrier 14 on a substrate and oxidizing a top layer of the diffusion barrier 14 to form a metal oxide layer 16 (i.e. nucleation layer), wherein the preparation process comprising exposing the diffusion barrier layer to an oxidant (i.e. cobalt oxide) and a reducing agent (i.e. nitrogen gas). A preparation process on the substrate is done to form a nucleation layer 16. The preparation process is done when $n = 1 - 20$ since the process repeated until the desired thickness of the metal oxide film is sufficient for the seed layer purpose. Reducing the oxidation state of the metal oxide layer 16 formed by oxidizing a top layer of the diffusion barrier to form a first seed layer 16 and depositing a conductor (i.e. a second Cu seed layer as seen in col. 2 lines 7-15) directly on the first seed layer 16 (i.e. metal layer) that has in composition from the nucleation layer after the preparation process is completed (see col. 1 lines 25-47, col. 5 lines 45-52, col. 6 lines 25-50, col. 7 lines 5-67, and col. 15 lines 65-67, and col. 17 lines 1-10). Soininen fails to disclose a seed layer that is different from the nucleation layer. Wu discloses a second layer 24 that is made of different material than the nucleation layer 22 (i.e. first seed layer) (see paragraph 23). Thus, Soininen and Wu have substantially the same environment of a barrier layer and two seed layers on a substrate. Therefore, one

skilled in the art at the time of the invention would readily recognize incorporating a different material for the first and second seed layers of Soininen, since the different materials would provide a reliable bond between seed layers while allowing the electrical connection between the metal interconnect and external device as taught by Wu.

With respect to Claims 34 and 35, Soininen discloses wherein depositing the conductor comprises depositing a second seed layer (i.e. ruthenium) by ALD (see col. 5 lines 1-14). Thus, allowing the copper to be deposited directly over the second seed layer.

With respect to Claim 36, Soininen discloses wherein the preparation process comprises exposing the substrate to a pulse of oxygen in a reactor chamber, purging the reactor chamber with an inert gas, exposing the substrate to a pulse of hydrogen, and purging the reactor chamber with an inert gas (see col. 6 lines 55-67 and col. 7 lines 20).

With respect to Claim 37, Soininen discloses exposing the substrate to a pulse for a ruthenium source chemical and purging the reactor chamber before exposing the substrate to the oxygen pulse (see col. 6 lines 25-67, col. 7 lines 20-67, and col. 8 lines 1-67).

With respect to Claims 44 and 45, one skilled in the art at the time of the invention would readily recognize substituting either an in-situ or remote hydrogen plasma for the hydrogen plasma, since both process would provide a stable method of for creating a seed layer on the barrier layer with a controlled rate.

With respect to Claim 52, Soininen discloses wherein depositing copper comprises an electrochemical deposition, electroless, or CVD process (see col. 3 lines 15-17).

4. Claims 46 and 47 are rejected under 35 U.S.C. 103(a) as being unpatentable over Soininen et al. (US 6,482,740) and Wu et al. (US 2005/0110147) as applied to claim 33 above, and further in view of Elers et al. (WO 01/29893).

With respect to Claim 46 and 47, it is well known in the semiconductor industry to have a diffusion barrier layer comprising a tungsten nitride carbide or molybdenum nitride carbide as evident by Elers (see pages 5, 9, and 10, claims 1-9). Therefore, it would have been obvious to one incorporate a tungsten nitride carbide or molybdenum nitride carbide for a barrier layer since the material would facilitate high quality ultra thin layer while providing corrosion protection for the substrate as taught by Elers.

5. Claim 38-43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Soininen et al. (US 6,482,740) and Wu et al. (US 2005/0110147) as applied to claims 33 and 36, and further in view of Aaltonen et al. (US 2003/0165615).

With respect to Claims 38-43, Soininen-Wu fails to explicitly recite the pulse of hydrogen and oxygen. However, it is well known in the semiconductor industry to have a hydrogen and oxygen pulse of 10 seconds or more as evident by Aaltonen (see paragraphs 53, 55, and 60, claims 1 and 11). Therefore, it would have been obvious to one skilled in the art to incorporate a pulse of 10 seconds or more with the process of Soininen-Wu, since the pulse would yield desired thickness of the film layer in an ALD environment as taught by Aaltonen.

6. Claim 51 is rejected under 35 U.S.C. 103(a) as being unpatentable over Soininen et al. (US 6,482,740) and Wu et al. (US2005/0110147) as applied to claim 33, and further in view of Chen et al. (US 6,753,249).

With respect to Claim 51, Soininen fails to disclose depositing copper by electrochemical deposition process. However, it is well known in the semiconductor industry that copper can be deposited by electrochemical deposition as evident by Chen (see col. 5 lines 14-17). Therefore, it would have been obvious to one substitute electrochemical deposition for electroless deposition since the electrochemical deposition would provide a reliable process to fill the trench as taught by Chen.

Allowable Subject Matter

7. Claims 1-28 are allowed.

The following is a statement of reason for the indication of allowance subject matter: the prior art of record does not teach or suggest the combination of oxidizing forms the metal oxide layer from metal in the diffusion barrier along with the other limitations in claim 1.

The prior art made of record and not relied upon is cited primarily to show the product of the instant invention.

Conclusion

8. Any inquiry concerning the communication or earlier communications from the examiner should be directed to Alonzo Chambliss whose telephone number is (571)

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272-1927.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-7956

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system Status information for published applications may be obtained from either Private PMR or Public PMR. Status information for unpublished applications is available through Private PMR only. For more information about the PMR system see <http://pair-dkect.uspto.gov>. Should you have questions on access to the Private PMR system contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free) or EBC_Support@uspto.gov.

AC/September 3, 2007

/Alonzo Chambliss/
Primary Examiner, Art Unit 2814